BREEDING SYSTEMS OF THE WESTERN AUSTRALIAN FLORA, I. *TRIGLOCHIN* L. (JUNCAGINACEAE)

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SUMMARY

Seventeen populations, comprising 10 taxa, of the genus *Triglochin* were analysed for types of breeding system. In all cases the taxa were found to be wind pollinated, self compatible and capable of self pollination. Seeds were dispersed by water for the perennial species, but no special means of dispersal were found in the small annuals.

INTRODUCTION — General

Little is known about the basic biology of most of our native flora. For most species there are no data on any aspect of their life history (e.g. length of life, flowering times, pollination biology, seed dispersal and seedling establishment). It is essential that a substantial amount of such data be accumulated so that an understanding of how our unique flora evolved and now maintains itself will be acquired.

Considering the latter point in more detail; it is well known that many species, members of the genera *Banksia, Macropidia, Lachnostachys* and *Ptilotus,* set only very small amounts of viable seed per plant, even with an abundant supply of pollination vectors. Exploration of the reasons for such seed set patterns may enable one to estimate accurately the number of adult plants needed within an area for replacement by seedlings to occur, and thus plan adequate reserves for these species.

Finally many of the above species are highly desirable subjects for cultivation, and a knowledge of the breeding system of a species is an essential prerequisite to any experimental breeding programme for the production of new cultivars.

This series will, hopefully, add a large amount of new data to our knowledge of the life histories of our flora, which will be of general use to biologists and naturalists interested in the flora of our state.

INTRODUCTION — Specific

Triglochin L. (water ribbons) is a small cosmopolitan genus of approximately 14 species. The extra-Australian species are all perennial herbs inhabiting shallow fresh water environments. These species are grown as fresh water aquaria plants, which is the only known economic use for members of the genus.

Although cosmopolitan, the majority of species (approximately 11 of the 14 known) are restricted to Australia, and chiefly to South-Western Australia, where about 8 species are endemic. These endemic species form a unique group within the genus in that they are annuals, not perennials and are not truly aquatic (habit, Fig. 1A). These species occupy shallow, sandy, winter wet depressions throughout South-Western Australia. They can be easily grown in pots, and have been successfully cultivated. However, they are not attractive subjects for horticultural purposes.

LIFE HISTORY

The annual species germinate in autumn, after the first heavy winter rains, vegetative growth occurs during winter, and flowering in spring. The plants die as the ground dries in early summer, and oversummer as seeds. Willis (1973) states that the "species of *Triglochin* bear fruits with spines, and are animal dispersed", this does not appear true for the native annuals which have no special means of dispersal. The seeds fall off the plant on to the ground, where they lie dormant until next autumn.

The perennials are still totally aquatic, and oversummer either by occupying permanent streams or dying back to their underground tubers (Fig. 1.B). Specimens of *T. procera* var. *duthiae* observed at Darlington in a permanent creek dropped their fruits directly into the water where they

floated away. Specimens of the same variety in an ephemeral pool at Cannington dropped the fruits into the drying mud. Flowering of the perennial species commences in early spring and may extend into January in some permanent pools, e.g. below the Mundaring Weir.

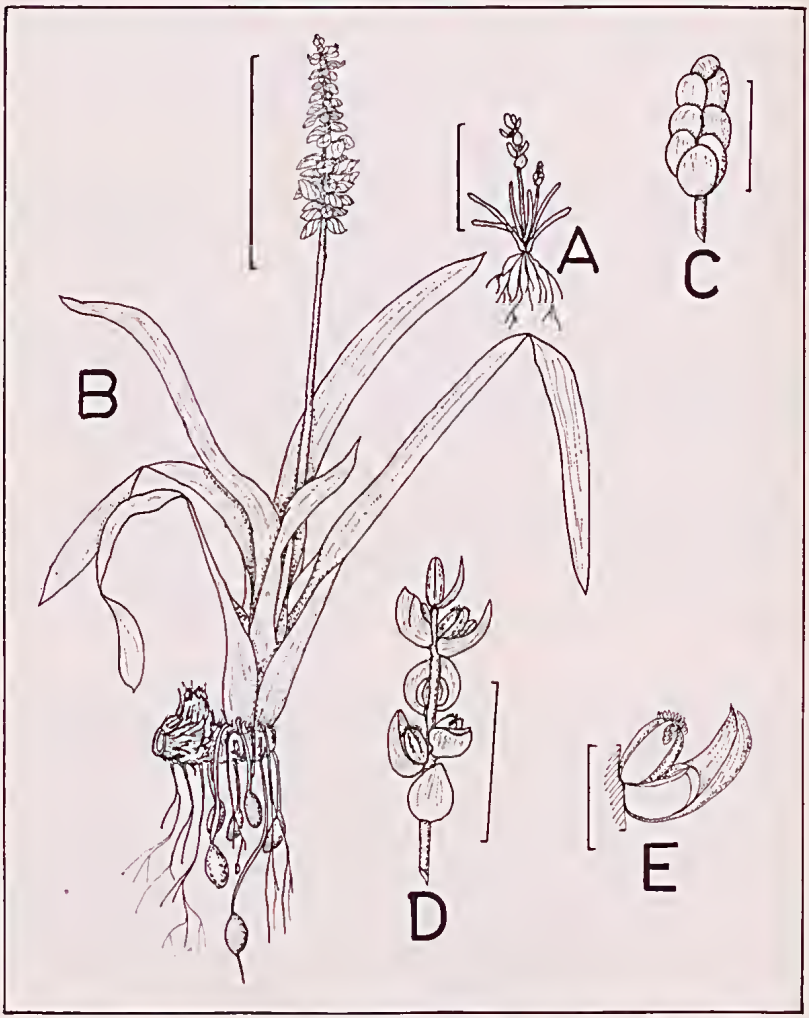

Fig. 1.—A. *Triglochin minutissima;* scale bar 3 cm. B. *T. procera;* scale bar 5 cm. C. *T. minutissima;* scale bar 10 mm, inflorescence, buds. D. *T. minutissima;* scale bar 15 mm, inflorescence, mature. E. *T. minutissima;* scale bar 5 mm, single flower.

POLLINATION SYSTEMS

Extra-Australian species are known to be wind pollinated (Faegri and Van der Pijl, 1971 and Pojar, 1974). All members of the genus bear small inconspicuous green flowers of a very simple construction (Figs. 1, C, D, E). No nectar or other attractants for animal vectors are found in the flower. The pollen which is dry and powdery is dehisced from the anther into a

boat shaped bract below (Fig. 1, E), and is kept there until shaken out by the wind. No insects were observed visiting any of the 7 taxa observed for several hours at Cannington, although other species of plants flowering nearby were attracting a diverse fauna. Ample pollen dispersal by wind was observed in several cases. The floral morphology and field observations demonstrate that the Australian species are also wind pollinated.

BREEDING SYSTEMS

Methods—For the annual species two plants per population were scored for each of the open and closed seed set data columns. The average seed set of these plants is presented in each column of Table 1.

For the perennial species two inflorescences, each from a separate plant, were scored and averaged per population for each column in Table 2. Very little variation between plants was noted in both instances.

Closed seed set was determined either by isolated potted material (annuals) or by placing glassine bags over the inflorescences in the field (perennials).

Initially in *T. minutissima* hand self and cross pollinations were carried out on individual flowers. This method proved unnecessary as shown in the results. Seed set in both hand self and cross pollination were exactly the same, no differences being detected by this alternate method.

Apomixis—Flower buds of four species were emasculated and bagged to detect the presence of apomixis (fruit setting without fertilization).

RESULTS AND INTERPRETATION

Nature of Breeding System—All species were found to be highly self compatible (Tables 1 and 2). There was no significant difference in any species between the amount of seed set in the field or by enforced selfing. All species were found capable of self pollinating (i.e. autogamous) when kept in isolation. This is in accord with the observations of Pojar (1974) on *T. maritima* in British Columbia, Canada.

Apomixis—In all four species tested (Table 3) removal of the anthers results in a lack of fruit and seed set. Some fruit development was noted in *T. minutissima*, but no seeds formed. It is probable, therefore, that the species are not apomictic, but further studies are needed on the other species of the genus.

TIME OF SELFING

Stigma squashes of isolated, recently opened flowers of the small annuals, just after anther dehiscence, invariably showed a deposition of pollen had occurred on the stigma. In the perennial species pollen was not deposited on the stigma during anther dehiscence but fell from other flowers when wind disturbance occurred. One isolated inflorescence placed in a sealed box did deposit considerable pollen on the plate below its container, so wind is not absolutely necessary for selfing to occur.

DISCUSSION

Open spaces of water are ideal for wind transport of pollen between plants, but this is not true for small enclosed patches of swampy soil. To successfully occupy such areas, as annuals, the species have enhanced the ability to self present in the perennial species, to ensure adequate seed set.

Seed dispersal has been reduced to a minimum in the annuals, ensuring that the species will occupy the same favourable area next year.

Finally this breeding system enables several distinct taxa to occupy the same site by precluding the chance for hybridization, as the species are self pollinated before crossing can occur. This situation has been also found in the genus *Darwinia* by Briggs (1964).

TABLE 1.—SEED SET FOLLOWING SELF AND CROSS POLLINATION OF ANNUAL MEMBERS OF THE GENUS *TRIGLOCHIN*.

Taxa	Area collection originated from	Open seed set/ plant (Field or pots outside)	Closed seed set
T. calcitrapa Hook.	Cannington	1.00	1.00
	Ongerup	1.00	1.00
	Capel	1.00	1.00
	Arrino	1.00	1.00
T. sp. 1 (GJK171) aff. *calcitrapa*	Cannington	1.00	1.00
T. centrocarpa Hook.	Cannington	1.00	1.00
	Tammin	0.95	1.00
	30 km S. Northampton	1.00	1.00
T. sp. 2 (GJK73) aff. *centrocarpa*	Cannington	1.00	1.00
T. mucronata R.Br.	Cannington	0.97	0.95
	10 km N. Esperance	1.00	1.00
T. mucronata R.Br. var nov (GJK204)	Kalbarri	1.00	1.00
T. minutissima F.v.M.	306 mile peg Lake King Road	1.00	1.00
	Cannington	1.00	1.00

TABLE 2.—SEED SET FOLLOWING SELF AND CROSS POLLINATION OF PERENNIAL MEMBERS OF THE GENUS *TRIGLOCHIN*.

Taxa	Area collection originated from	Open seed set/ inflorescence (Field)	Closed Seed Set
T. procera R.Br. var *procera*	Capel	0.91	1.00
T. procera R.Br. var *duthiae*	Cannington	1.00	1.00
T. striata Ruiz and Pov	Moore River	0.92	—
	Busselton	—	0.89

TABLE 3.—TESTS FOR APOMIXIS (ALL FROM CANNINGTON).

Taxa	No. flowers emasculated	Fruit development	Seed Set
T. procera var *duthiae*	6	0	0
T. centrocarpa	5	0	0
T. sp. 1	5	0	0
T. minutissima	10	4	0

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